APPENDIX TO MARCH 27, 2006 AMENDMENT

Patent Application No.: **10/041,082**

Copy of Interview Discussion Outline Submitted by E-mail to Examiner on March 21, 2006 prior to the Interview

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Attorney Docket No.: **HA-87 (HAL-ID 202)**

Appl. No.: **10/041,082**

Applicant: **Carl SCARPA**

Filed: **January 7, 2002**

Title: **CHANNEL ESTIMATION AND COMPENSATION TECHNIQUES FOR USE IN FREQUENCY DIVISION MULTIPLEXED SYSTEMS**

TC/A.U.: **2661**

Examiner: IAN MOORE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
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INTERVIEW OUTLINE

Sir:

This interview outline is being submitted to assist the Examiner in preparing for the March 21, 2006 in-person interview scheduled for 2 pm.

Amendments to the Claims appear in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 11 of this paper.

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This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (original): A method of processing a frequency division multiplexed signal including a plurality of tones, the method comprising:

receiving said frequency division multiplexed signal; and

performing a constant modulus based update operation to update a channel estimate corresponding to at least one tone of the frequency division multiplexed signal.

Claim 2 (currently amended): The method of claim 1 ~~2~~, further comprising:

using the updated channel estimate to perform a channel compensation operation on a portion of the frequency division multiplexed signal corresponding to said at least one tone.

Claim 3 (original): The method of claim 1, further comprising:

performing a reduced constellation decision directed update operation to update said channel estimate.

Claim 4 (original): The method of claim 3, further comprising:

performing a full constellation decision directed update operation to update said channel estimate.

Claim 5 (original): The method of claim 4, further comprising:

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receiving, as part of said frequency division multiplexed signal, a pilot transmitted on said at least one tone; and

using said received pilot to update said channel estimate.

Claim 6 (original): The method of claim 1, further comprising:

generating a signal noise measurement value for said at least one tone;

comparing the signal noise measurement value to a first threshold; and

selecting a channel estimate update method, as a function of the comparison of the signal noise measurement value to the first threshold, from a plurality of different channel estimation update methods.

Claim 7 (original): The method of claim 6, wherein the plurality of different channel estimation update methods include at least one of a constant modulus based update method and an interpolated pilot value based method.

Claim 8 (original): The method of claim 6, wherein the plurality of different channel estimation update methods include at least one of a reduced constellation decision directed update method and a full constellation decision directed update method.

Claim 9 (original): The method of claim 6, further comprising:

when said comparison of the signal noise measurement value to the first threshold indicates that the

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signal noise measurement value does not exceed said first threshold,

comparing the signal noise measurement value to a second threshold; and

wherein the step of selecting a channel estimate update method is also performed as a function of the comparison of the signal noise measurement value to the second threshold.

Claim 10 (original): The method of claim 9, wherein a reduced constellation decision directed channel estimate update method is selected when the comparison of the signal noise measurement value to the second threshold indicates that the signal noise measurement value exceeds the second threshold and wherein a full constellation decision directed channel estimate update method is selected when the comparison indicates that the signal noise measurement value is below the second threshold.

Claim 11 (original): The method of claim 1, further comprising:

performing a decision directed channel estimate update operation to update a channel estimate corresponding to a second tone of the frequency division multiplexed signal at the same time said constant modulus based update operation is performed.

Claim 12 (original): A method of updating channel estimates corresponding to different tones of an orthogonal frequency division multiplexed communications signal, the method comprising, for each of at least two tones of the communications signal, performing the steps of:

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generating a signal noise measurement for the tone,

selecting a channel estimate update method for the tone, from a set of at least three different channel estimate update methods, based on a comparison of the generated signal to at least one threshold; and

updating a channel estimate for the tone using the selected channel estimate update method.

Claim 13 (original): The method of claim 12, wherein the set of at least three different channel estimate update methods includes a reduced constellation decision directed update method.

Claim 14 (original): The method of claim 13, wherein the set of at least three different channel estimate update methods further includes a constant modulus based channel estimate update method.

Claim 15 (original): The method of claim 14, wherein the set of at least three different channel estimate update methods further includes a full constellation decision directed update method and an interpolated pilot based channel estimate update method.

Claim 16 (original): The method of claim 12, wherein the set of at least three different channel estimate update methods includes a constant modulus based channel estimate update method.

Claim 17 (original): The method of claim 16, further comprising the step of using the updated channel estimate

generated for each of the tones to perform a channel compensation operation.

Claim 18 (original): A method of updating a channel estimate for a carrier signal of an orthogonal frequency division multiplexed communications signal, the method comprising:

receiving the carrier signal; and

performing a reduced constellation decision directed channel estimate update operation, using the received carrier signal, to update said channel estimate.

Claim 19 (original): The method of claim 18, further comprising:

after performing said reduced constellation decision directed channel estimate update operation performing a full constellation decision directed channel estimate update operation.

Claim 20 (original): The method of claim 19, further comprising:

generating a signal noise measurement;

comparing the signal noise measurement to a threshold; and

using the results of the comparison to determine when to switch from performing said reduced constellation decision directed channel estimate update operation to performing the full constellation decision directed channel estimate update operation.

Claim 21 (original): A method of updating a channel estimates for carrier signals of an orthogonal frequency

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division multiplexed communications signal, the method comprising:

receiving the carrier signals; and

performing a reduced decision directed channel estimate update operation, for at least a first plurality of the received carrier signals of said orthogonal frequency division multiplexed communications signal.

Claim 22 (original): The method of claim 21, further comprising:

comparing a signal noise value to a threshold; and

selecting for at least one of said received carrier signals, as a function of said comparison, between performing a decision directed channel estimate update operation and performing a constant modulus based channel estimate update operation.

Claim 23 (original): The method of claim 22, wherein a constant modulus based channel estimate update operation is performed for one carrier signal at the same time a reduced decision directed channel estimate update operation is performed for another carrier signal.

Claim 24 (original): A method of updating first and second channel estimates corresponding to a first and a second carrier frequency of an orthogonal frequency division multiplexed signal, the method comprising:

generating first and second signal noise measurements for the first and second carrier frequencies, respectively;

independently comparing each of the first and second signal noise measurements to at least one noise threshold

to independently select a channel estimate update method to be used to update the first and second channel estimates, respectively the channel estimate update methods including at least one of an amplitude only update method and a reduced constellation decision directed update method.

Claim 25 (original): The method of claim 24, wherein the first and second signal noise measurements are signal to noise ratio measurements and where the first threshold is a first signal to noise ratio threshold

Claim 26 (original): A receiver apparatus for receiving and processing an orthogonal frequency division multiplexed signal, the apparatus comprising:

a carrier recovery module for performing a carrier recovery operation on the multiplexed signal;

a channel compensation module coupled to the carrier recovery circuit for performing channel compensation operation on each tone of the orthogonal frequency division multiplexed signal;

a signal noise measurement module for generating, for each tone, a signal noise measurement; and

a channel estimate update selection module for selecting between an amplitude only channel estimate update method and an amplitude and phase channel estimate update method, for each individual tone, as a function of the signal noise measurement generated by said signal noise measurement module for the individual tone.

Claim 27 (original): The apparatus of claim 26, further comprising:

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means for generating an updated channel estimate for each tone of the multiplexed signal as a function of the selected channel estimate update method, coupled to said channel compensation module and said channel estimate update selection module.

Claim 28 (original): The apparatus of claim 27, wherein the amplitude only channel estimate update method is a constant modulus based channel estimate update method.

Claim 29 (original): The apparatus of claim 28, wherein the amplitude and phase channel estimate update method is a reduced constellation decision directed update method.

Claim 30 (original): An apparatus for updating channel estimates in a frequency division multiplexed receiver, the apparatus comprising:

a plurality of channel estimate update modules, said plurality of channel estimate update modules including:

i) a constant modulus channel estimate update module for performing a channel estimate update for a tone of a frequency division multiplexed signal using a constant modulus algorithm; and

ii) a full decision directed channel estimate update module for performing a full decision directed channel estimate update for a tone of a frequency division multiplexed signal; and

a control module for selecting, as a function of a signal measurement, one of said plurality of channel estimate update modules to be used for performing a channel estimate update operation.

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Claim 31 (original): The apparatus of claim 30,

wherein said signal measurement is a signal noise measurement, the apparatus further comprising a signal noise measurement module coupled to said control module; and

wherein said plurality of channel estimate update modules further includes a reduced decision directed channel estimate update module.

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REMARKS/ARGUMENTS

Applicants respectfully submit that the outstanding rejections are all based under 35 U.S.C. §103 based on various Examiner proposed combinations of references which seem to fail to take into consideration the teachings of the references a whole.

Applicants representative intends to step through the applied references and rejections one by one and discuss what the references actually show and how the references do not teach or suggest the combinations asserted by the Examiner.

For example, with regard to the rejection of claims 1, 2, 5-7, 12, 17 and 25 the Examiner asserts these claims are unpatentable over the Wright patent in view of Rupp.

The cited portion of the Wright patent (col. 10 lines 24-32) describes the use of a channel estimator 520 which estimates the effects of the channel based on extracted pilot symbols.

The Examiner further cites col 13, lines 35-37 stating that the reference teaches "calculating a channel estimation and updating it periodically (column 10 lines 24-32) using techniques that are known in the art (column 13, lines 35-37)." (Office Action page 2)

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The cited portion when considered in the slightly broader context of the full sentence provided at col. 13, lines 33-37 states:

> The **extracted pilot symbols are then compared with their expected values** (i.e., their values prior to transmission over the wireless channel) **to perform channel estimation** and compensation using techniques that are known in the art. (Bold added for emphasis)

Accordingly, it is respectfully submitted that a fair reading of the Wright patent is that it is describing the use of channel estimation **based on extracted pilots which are compared to their expected values, this is a decision directed process** since it depends on a comparison between the extracted pilot symbol and the expect value. While various methods may be known for implementing such a decision directed channel estimation process, such methods are not any arbitrary known channel estimation technique or a constant modulus technique as the Examiner seems to suggest by citing RUPP.

Applicants argument that it would not be obvious or desirable to replace the decision directed process described in Wright with a constant modulus method is further supported by the statement at col 10, lines 24-25 of Wright which states "The channel estimator 520 **compares the amplitudes and phases** of the extracted pilot symbols with the expected **amplitudes and phases**, to thereby estimate the effects of the channel on the transmitted signal." The Wright patent indicates that

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this is used in determining the "phase impairment" in addition to "amplitude impairment".

Applicants respectfully submit that constant modulus algorithms do not provide information on phase impairment. (See Applicants application page 8 lines 3-9)

Accordingly, one of ordinary skill in the art reading the Wright patent would not be motivated to replace the decision directed system which provides both phase and amplitude information with one that provides simply amplitude information as would be the result if the decision directed technique of would not be motivated to replace the decision directed system which provides both phase and amplitude information with one that provides simply amplitude information as would be the result if the decision directed technique of Wright were replaced with a constant modulus method as the Examiner asserts would be obvious.

Applicants' representative intends to discuss the other references used to reject the claims during the interview as well and suggest the Examiner look over the cites to the Koslov patent in the office action and what is actually disclose in the applied patent.

Respectfully submitted,

Michael Straub